Owner/Operator Manual

Ecostar™ Power Converter
Nextek Power Gateway

Model Name:	Dual Source DC Power Supply, Photovoltaic & Line Powered
Model Number:	EPC-PV/DC-480-75kW
Part Number:	5107386
Document Number:	MAN5100171
Date:	Aug 30, 2005
Modified	November 1, 2005 by Nextek Power Systems
New Document #	MAN5100171(N)

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Owner/Operator Manual

Nextek Power Gateway

Ecostar™ Power Converter

IMPORTANT SAFETY INSTRUCTIONS
SAVE THESE INSTRUCTIONS

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Ballard Power Systems Inc.
15001 Commerce Drice North
Dearborn, MI 48120 USA
Tel: 800-536-1126 Ext 15
Fax: 313-583-5990
E-mail: epc.service@ballard.com

Nextek Power Systems, Inc.
89 Cabot Court, Suite L
Hauppauge, NY 11788
(631) 750-1000
Email: Service@NextekPower.com

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WARNING: This unit generates high voltage. Obey ALL warnings, cautions, and safety instructions. Failure to do so may result in electrical shock leading to personal injury or death.

(i) Disclaimer

There may be variance in the exact procedures used to operate the unit. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Before departing from the instructions laid out in this manual, the operator must first establish that neither personal safety nor the integrity of the unit are compromised.

(ii) Glossary

Abbreviation	Term
A	Ampere
AC	Alternating Current
AWG	American Wire Guage
CAN	Controller Area Network
CIU	Customer Interface Unit (Circuit Board)
DC	Direct Current
Delta	Mesh-connection
ISO	International Organization for Standardization
ITB	Interface Terminal Block (Circuit Board)
kVA	Kilovolt Amperes
kW	Kilowatt
MIC	Main Inverter Controller (Circuit Board)
MPPT	Maximum Power Point Tracking
MS	Milli-second
MSDS	Material Safety Data Sheet
OEM	Original Equipment Manufacturer
PV	Photo-Voltaic
SIC	Source Inverter Controller (Circuit Board)
RMS	Root mean-square
V	Volt
VAC	Voltage, Alternating Current
VDC	Voltage, Direct Current
VSP	Voltage Sense Precharge (Circuit Board)
WYE	Star-connection

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(iii) Symbols Used

In this document, the following symbols are used:

	Danger of electric shock hazard
	Warning. Failure to follow procedures may result in injury or death to the operator
	Direction of handle movement to turn the switch ON
	Direction of handle movement to turn the switch OFF
	Ground connection to the building ground
	Chassis connected to ground

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SECTION 100 Preface

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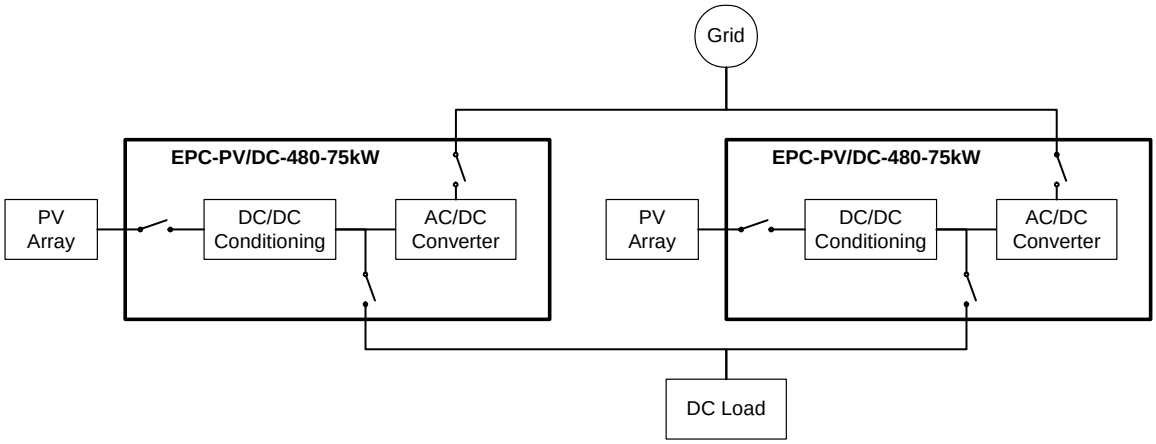
Introduction

Ballard's Dual Sourced, photovoltaic (PV) and AC line powered, Ecostar™ Power Converter, is designed to condition power from PV arrays, supplemented by rectified DC power from utility, to provide a nominal 380 Volt DC power bus primarily intended for DC lighting as shown in the diagram below.

Nextek Power Systems and Ballard Power Systems.

The Nextek Power Gateway was designed by Nextek utilizing their patented Direct Coupled® technology. Under contract to Nextek, Ballard Power Systems has modified their Ecostar™ 75kW inverter to utilize this technology.



Dual Sourced Power Converter Functional Diagram

The converter system consists of the following:

- DC to DC power conditioning, monitoring & overvoltage protection
- AC to DC, power factor corrected, active rectification
- Paralleling controls to control load sharing between multiple converters
- A user interface consisting of a display panel with on/off switch, an E-Stop button, a 4-line vacuum-fluorescent display, a keypad, and status LED indicators
- An AC input contactor and fused disconnect for the line source
- A DC input contactor for the PV source
- A DC output contactor and fused power distribution block (PDB)
- Input/output voltage, current, and temperature sensors for control and protective functions
- A software-selectable, ground-fault detection scheme on the 380V DC bus
- An enclosure designed for indoor or outdoor use

The converter uses trench-gate IGBTs with customized gate drivers equipped with advanced fault diagnostics and reporting capability. The power devices are liquid cooled to provide extended reliability. The controllers are based on automotive qualified processors with on-board flash and dual CAN communication ports.

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The EPC-PV/DC series is designed to track the PV array's operating conditions to provide maximum power from the array to the load. It automatically transitions between PV sourced and line sourced power to the DC load. The system constantly checks for available power, and when energy is not available, it transitions to rectified power mode. During transient conditions, such as a cloud passing over the array, the unit will blend AC sourced power to regulate DC voltage and provide sufficient power to the load.

The EPC-PV/DC series is designed for two converters to operate in parallel, sharing the load and providing N+1 redundancy for the DC load.

The EPC-PV/DC does not export power to the utility source.

The EPC series can be programmed through a keypad/display user interface or via a PC. Operational trip points can be set through the control panel with the use of a password.

When the EPC is not on, the input isolation transformer is disconnected from the AC source and will not consume any magnetizing power.

The EPC-PV/DC is designed to UL 1741 standards, and is manufactured in a UL certified facility. This facility holds QS 9000, ISO 9001, and ISO 14001 certifications.

How to Use This Manual

Consult the main table of contents at the beginning of the manual to determine which section contains the information you desire. From there, navigate to the appropriate section and consult the section index to find the particular topic you are seeking.

There may be variance in the exact procedures used to operate the unit. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Before departing from the instructions laid out in this manual, the operator must first establish that neither personal safety nor the integrity of the unit are compromised.

For more information on the installation of the unit, consult the Installation Manual.

For more information on servicing the unit, consult the Service Manual (available to trained personnel only).

IMPORTANT SAFETY INSTRUCTIONS SAVE THESE INSTRUCTIONS

Warnings and Cautions

This manual contains **WARNINGS** and **CAUTIONS**. Warnings indicate actions that may result in an accident, which could cause bodily injury or death. Cautions indicate procedures that could result in damage to the unit. **Observe all WARNINGS and CAUTIONS**. Failure to do so may result in personal injury or damage to the unit.

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The following list contains some general **WARNINGS** that should be followed at all times when working around the unit:

- **ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION**
- **MAKE SURE THAT POWER HAS BEEN DISCONNECTED FROM THE UNIT BEFORE SERVICING, UNLESS REQUIRED BY THE PROCEDURE**
- **DO NOT SMOKE WHILE WORKING ON THE UNIT**
- **FOLLOW ALL INDUSTRY-RECOMMENDED SAFETY PROCEDURES AND STANDARDS WHEN SERVICING THE UNIT**

Safety Instructions

Careful observance of the following safety instructions should be adhered to at all times:

General

- **Unit suitable for OUTDOOR or INDOOR installation.**
- **Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used.**
- **Use approved safety equipment (explosion-proof lights, blowers, etc.) when using cleaners. Be sure that fire-fighting equipment is readily available.**
- **Keep cleaners and solvents in special polyethylene bottles or in safety cans in minimum quantities. Discard soiled cleaning rags into safety cans.**
- **Adhere to the MSDS documentation when handling the coolant.**
- **Keep all guards, screens, and electrical enclosures in place when the system is operating.**
- **Close the inverter enclosure before energizing the unit.**
- **Use only authorized replacement parts or hardware when servicing the unit.**
- **Keep vents clear of debris and provide proper airflow.**

High Voltage Electrical Equipment Maintenance

- **The system is powered by multiple power sources. Disconnect ALL sources and use proper Lock-Out/Tag-Out procedures before opening the doors, or before working on the transformer or the cooling system.**
- **Even though the fuse switch may be turned off, if the unit is connected to the grid use caution when working around the top terminals, as they are still connected to the grid.**
- **Disconnect the PV array before servicing the unit, as the PV array may hold a residual charge.**
- **<u>There are no door interlocks on the unit</u>**
- **The inverter has charged DC-link capacitors that will hold a charge for up to 5 minutes after the unit has been isolated from the PV array and disconnected from the power grid. Wait for 5 minutes before opening the doors.**

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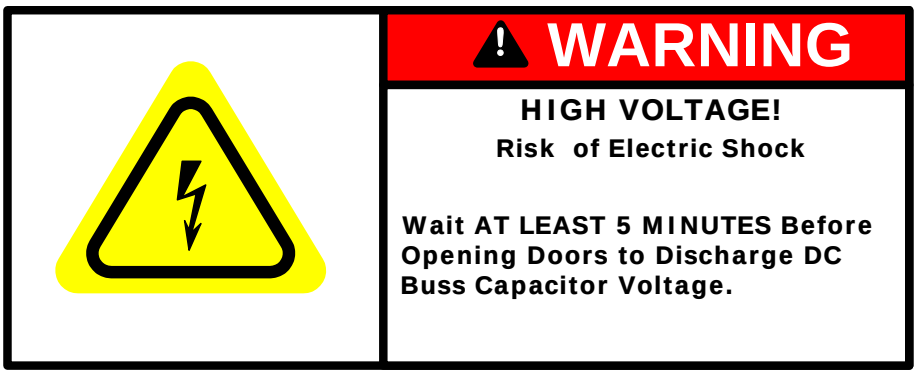
- **The ac disconnect needs to be in the off position before the door can be opened. This isolates the ac form the unit. To isolate the dc the external dc disconnect should be turned off.**
- **Remove jewelry, watches, rings, and metal objects that can cause short circuits.**
- **Use anti-static wristbands when servicing electronic components.**
- **Observe proper Lock-Out/Tag-Out procedures when working on the inverter system, the transformer, and the cooling system.**
- **Disconnect all power sources before servicing. Switch the fuse switch to the OFF position before working on the transformer.**
- **Isolate the 12V battery and allow the capacitors to discharge for 5 minutes before servicing.**
- **Be sure that all electrical connections and connectors are properly installed and connected with proper torque. Torque specifications for terminals can be found in the Torque Specifications section.**
- **For continued protection against risk of fire, only use replacement fuses of the same type and rating as the original fuse.**
- **Avoid hazardous voltage situations that could result from unsafe conditions such as, but not limited to, the following:**
  - **Back-feed from the utility**
  - **Improper grounding**
  - **Handling electrical leads or devices with wet hands or on wet ground**
  - **Frayed electrical leads**
  - **Working with or on an electrically hot system or component, or when connected to an energized load**
  - **An ungrounded battery pack**
  - **Improper connection or re-connection of the terminal leads**
  - **Short circuits**
  - **Energized normal and emergency power sources**


WARNING
HIGH VOLTAGE!
Risk of Electric Shock
Wait AT LEAST 5 MINUTES Before Opening Doors to Discharge DC Buss Capacitor Voltage.

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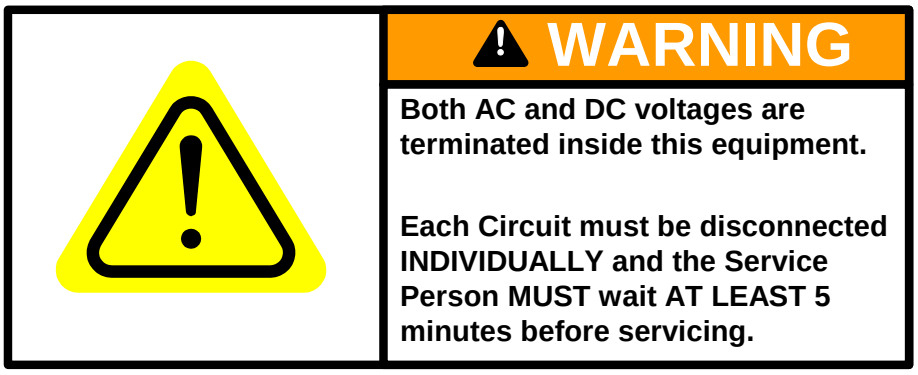
WARNING
Both AC and DC voltages are terminated inside this equipment.
Each Circuit must be disconnected INDIVIDUALLY and the Service Person MUST wait AT LEAST 5 minutes before servicing.

Inspection and Storage

Upon receiving the unit, inspect for signs of damage that may have been caused during shipping. If damage is found, contact your authorized Ballard distributor or the factory.

Verify that the Emergency Power Off (EPO) switch, located on the control panel, has not been activated during shipping. If it is engaged, disengage the EPO switch before proceeding by resetting the switch (the switch is reset by turning it clock-wise).

Warning. Do NOT attempt to lift and/or move the unit by hand. It is extremely heavy. Attempting to move the unit by hand may lead to serious injury.

The inverter system (inverter, output isolation transformer, and cooling system) weighs approximately 2,000 lbs. Use a pallet jack or forklift to move the unit. **Do NOT attempt to lift and/or move the unit by hand**.

For mounting the cooling system to the enclosure, a “leg” is shipped with the system. The cooling system weighs approximately 200 lbs. Care should be taken when moving the system.

See *Section 200, Specifications*, for information on the specific environmental requirements for unit location and storage.

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Dimensions and Clearances

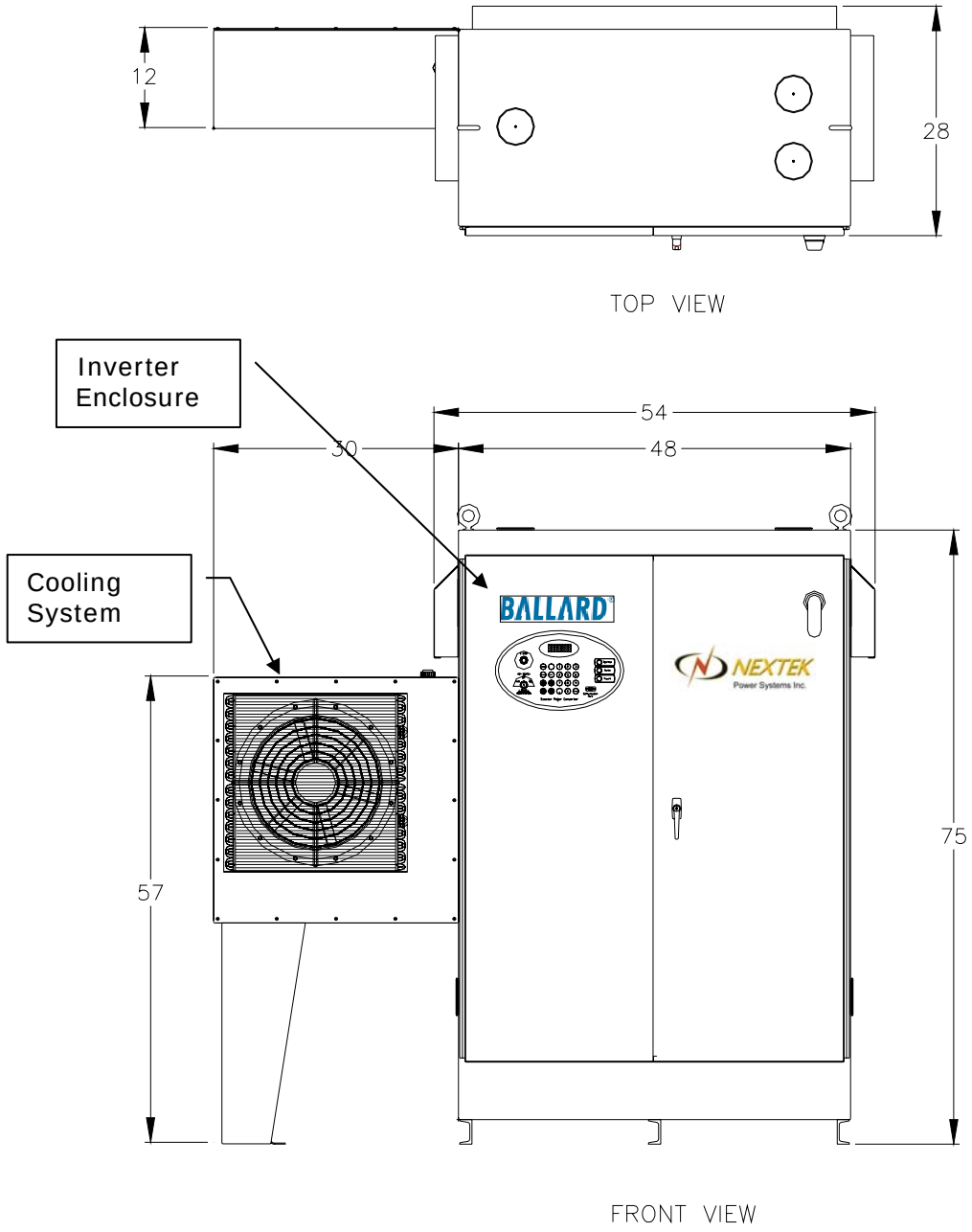

Fig. 1 – Inverter System Overall Dimension (inches)

The dimensions of the unit (in inches) are shown in **Figure 1**. The vents on the main enclosure are located on the rear and sides. Air enters from the top vents and exhausts through the vents located in the lower rear.

The cooling system fan takes air from the front and exhausts it to the rear. When installing the unit, maintain at least 12 inches of clearance from the rear of the enclosure and the cooling system.

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The output isolation transformer takes air from the bottom of the enclosure. Be sure that the transformer is mounted on a clear floor that allows free flow of air.

Always allow 2-3 feet of clearance around the unit to provide space for operating/working on the unit.

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SECTION 200 Specifications

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System Specifications

DC Photovoltaic Input	
Nominal Voltage	380 VDC
Operating Voltage Range	360 – 400 VDC
Maximum Current	240 Amps DC
Maximum Voltage	600 VDC
AC Line Input	
Phases	3-phase with neutral
Nominal Voltage (Line-Line)	480 V rms
Maximum Continuous Current	94 Amps rms
Nominal Frequency	60 Hz
Voltage Range (Full Output Power)	432 - 552 V rms
Voltage Range (De-Rated Output Power)	240 - 431 V rms (See Figure 3)
Frequency	59.3 – 60.5 Hz
Power Factor	>0.97
Maximum Branch Circuit Current	107 Amps rms
Maximum Continuous Power	75 kW (user-adjustable)
Maximum Current into the Source	0 Amps
Maximum Input Fault Current	<600 Amps (peak) for < 2ms
Harmonics	
AC Input Current (TDD)	<5%
DC Output	
Rated Power	75 kW
Maximum Power (Dual Sourced)	96 kW
Maximum Power (3 - Phase Line Sourced)	75 kW
Maximum Power (Single Phase Open)	50 kW
Minimum Operating Power	20%, 15 kW
Nominal Voltage	380 VDC
Operating Voltage Range	360 – 400 VDC steady state (Transient-not less than 350 V for 1 sec)
Maximum Voltage	405 VDC for less than 200 msec (Transient-415 V for 0 sec)
Maximum Current	240 Amps DC for less than 60 sec (Overcurrent trips in 1 sec at 260 A)
DC Voltage Ripple	<5%, 19 V Pk-Pk
Load Sharing (2 Unit)	+/- 20% in < 6 sec
Environment	
Maximum Ambient Temperature	50°C (122°F) Full Power
Operating Ambient Temp. Range	-20°C to 50°C (-4 to 122°F)
Storage Temperature Range	-30°C to 60°C (-22 to 140°F)
Cooling System	
Capacity	1.5 gallons
Fluid Type	50/50 ethylene glycol/water mixture*

*Any readily available, ethylene glycol-based, automotive grade coolant may be used.

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Wiring Specifications

See Installation Manual.

Unit Dimensions

See Installation Manual

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SECTION 300 Preparing for Operation

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Keys to the Enclosure

The key will unlock the enclosure doors. When the unit is initially shipped the keys (in duplicate) are placed in the door pocket in an envelope. To order replacement keys, contact your authorized Ballard distributor.

Safety Check

Performing a routine safety check every time before starting the unit will minimize the risk of injury to the operator and minimize the potential for damaging the unit. Before operating the unit, check for obvious signs of damage or concern. The following is a list of suggested items to be checked before operating the unit:

- Check the enclosure for obvious signs of damage.
- Verify that all inlet and outlet vents are clear of debris.
- Check external wires and cables for signs of damage, such as fraying or cracked insulation.
- Check the cooling system for signs of leaks, and verify that the coolant level is within normal limits.
- Check room for potential hazards, such as standing water on the floor.

NOTE: Additional safety checks may be necessary depending on the particular installation of the unit. The safety checklist above is not intended to be all-inclusive.

Resolve all issues before operating the inverter. Contact your authorized Ballard distributor, if necessary.

Factory Default Settings

The following charts list predefined values for key variables, and default values for user-adjustable set points. To change the factory default settings, refer to *Section 500, Operating the Unit*.

Predefined Setting	Default
Reconnect Delay	5 min.

(continued)

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User Adjustable Parameter		Set Point			Minimum Step Size
Display	**Description**	**Default**	**Range**	**% of Nominal**	
GFD Current Threshold	Ground Fault Detection Current Threshold	7 A	0-100 A	-	0.1 A
Maximum kW	Maximum PV Array Power	80 kW	0-80 kW	-	0.1 kW
OF cond1	Over Frequency Trip Time	100 ms.	32-100 ms.	-	1 ms.
OF lmt1	Over Frequency Limit	60.5 Hz	60-60.5	-	0.1 Hz
OV cond1	Slow Over Voltage Trip Time	1900 ms.	32-1,900 ms.	-	1 ms.
OV cond2	Fast Over Voltage Trip Time	30 ms.	30 ms.	-	1 ms.
OV lmt1	Slow Over Voltage Trip Level	132 V	127-132 V	106-110%	0.1 V
OV lmt2	Fast Over Voltage Trip Level	139 V	132-139.2 V	110-116%	0.1 V
PF	Power Factor	0.99	-	-	Fixed
UF cond1	Slow Under Frequency Trip Time	100 ms.	32-100 ms.	-	1 ms.
UF cond2	Fast Under Frequency Trip Time	100 ms.	32-100 ms.	-	1 ms.
UF lmt1	Slow Under Frequency Limit	59.3 Hz	59.3-60	-	0.1 Hz
UF lmt2	Fast Under Frequency Limit	57.0 Hz	56-60	-	0.1 Hz
UV cond1	Slow Under Voltage Trip Time	1900 ms.	32-1,900 ms.	-	1 ms.
UV cond2	Fast Under Voltage Trip Time	60 ms.	32-60 ms.	-	1 ms.
UV lmt1	Slow Under Voltage Limit	105.6 V	105.6-114 V	88-95%	0.1 V
UV lmt2	Fast Under Voltage Limit	60 V	60-105.6 V	50-88%	0.1 V

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SECTION 400 Understanding the Control Panel

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Overview

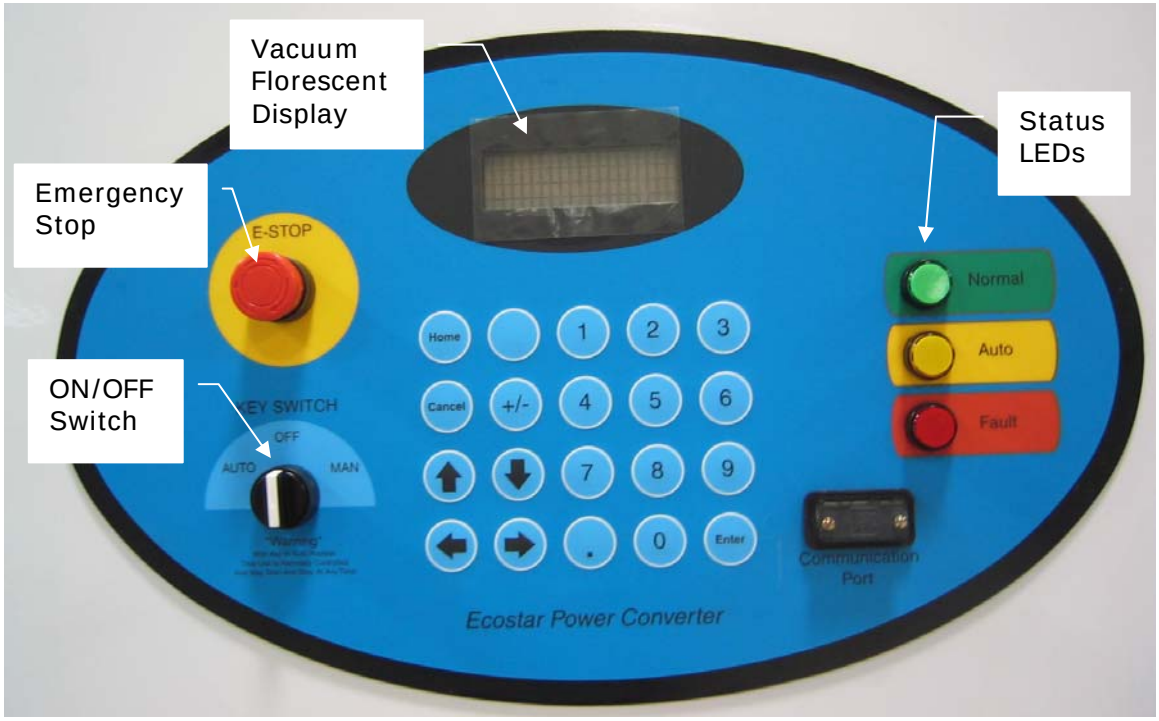

Fig. 1 – Control Panel

Figure 1 shows the control panel with its corresponding features.

VFD Display

The control panel contains a Vacuum Fluorescent Display (VFD) with four text lines, capable of twenty characters per line. The display characters are colored green on a black background.

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Status LEDs

The status array contains three different LEDs, colored Green, Yellow, and Red. The following chart illustrates the appropriate function of each LED:

LED Color	Status	Description
Green	ON	Inverter is in active power delivery or sleep mode
Yellow	WARNING (solid)	Maintenance mode
	WARNING (flashing)	Warnings are present in the system
Red	SHUTDOWN (solid)	Shutdown due to an internal fault, or array ground fault

If the Yellow LED is flashing, the system has detected a warning. A warning message will appear on the control panel display. When the warning is cleared, the system will return to normal operation.

If the Yellow LED is on solid, this indicates that the system is operating in Maintenance Mode.

If the Red LED is on solid, the detected fault could not be cleared and the unit has entered a Shutdown Mode. An error messages will appear on the control panel display. The fault conditions must be cleared, and the On/Off switch cycled before the unit can begin operating normally.

Refer to *Section 700, Troubleshooting,* for help with warning messages.

RS-232 Communications Port

This port is used for local communications and for interfacing with a laptop computer. Presently, this port is reserved for later use.

(continued)

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Keypad

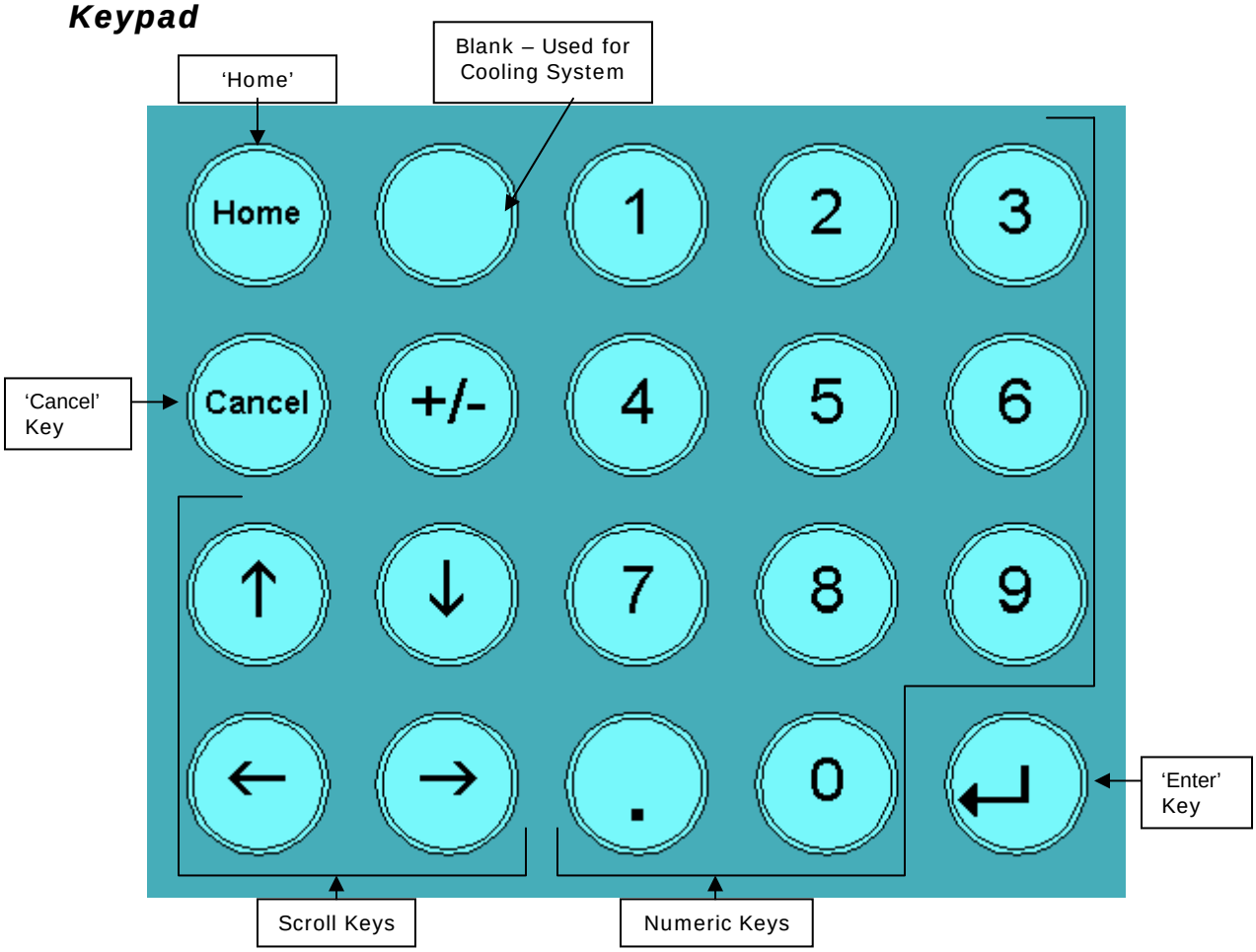

Fig. 2 – Control Panel Keypad

The keypad layout is shown in **Figure 2**. The keypad consists of 20 membrane switches. The various keys are used for inputting data or configurations into the inverter. As such, the keypad serves as the main interface between the operator and the unit.

On/Off switch

The On/Off switch has three positions, MAN (Manual), AUTO (Automatic), and OFF. For normal operator control, turn the switch to the MAN position. Currently AUTO function is same as MAN. To turn the system OFF, turn the switch to the OFF position. Activate the EPO switch whenever the unit is not in use for prolonged time. This will prevent the back-up battery from discharging.

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Emergency Stop Switch

The emergency power off (E-Stop) switch is wired to all of the internal modules. When pressed, the switch will immediately cease power output to the grid and drop the contactor K1 to isolate the unit from the grid. However, this will NOT disconnect the array from the inverter.

Basic Display/Keypad Operation

The following is a list of the keypad buttons and their respective functions:

- ←, →
  - Used for selecting discrete parameter choices

- ↑, ↓
  - Scrolls the display pointer up and down. These keys are also used to navigate between pages/screens. When the arrowhead is at the beginning of an item, that item is currently active.

- 'Enter' Key
  - Selects items within a display screen. The active item is either represented with an arrowhead at the beginning of the line, or may be a flashing cursor in the case of entering a numeric value during data entry operations.

- 'Home' Key
  - Takes user directly to the default screen from any sub-screen. The default screen is the Status→Current State screen.

- 'Cancel' Key
  - Can be pressed at anytime to revert to an old value that was set prior to pressing the 'Enter' Key.

If a key is held down, the control panel will interpret this as a single keystroke, rather than producing multiple entries. Releasing the key will return the control panel to normal operation.

When* inverter *operation parameters are changed, software performs an out-of-range check on the values, and it will not accept an out-of-range entry.

Screen Saver

In order to lengthen the life of the display, it is recommended that a screen saver be used so that pixels are not left on for excessive lengths of time. Therefore, a screen saver has been built-in to the control panel.

If the keypad is inactive for more then forty-five (45) minutes, the screen saver is turned on. It consists of a '!' moving across the screen. While in screen saver mode, pressing any key will turn the screen saver off and the user will be taken to the Status-Current State screen.

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SECTION 500 Operating the Unit

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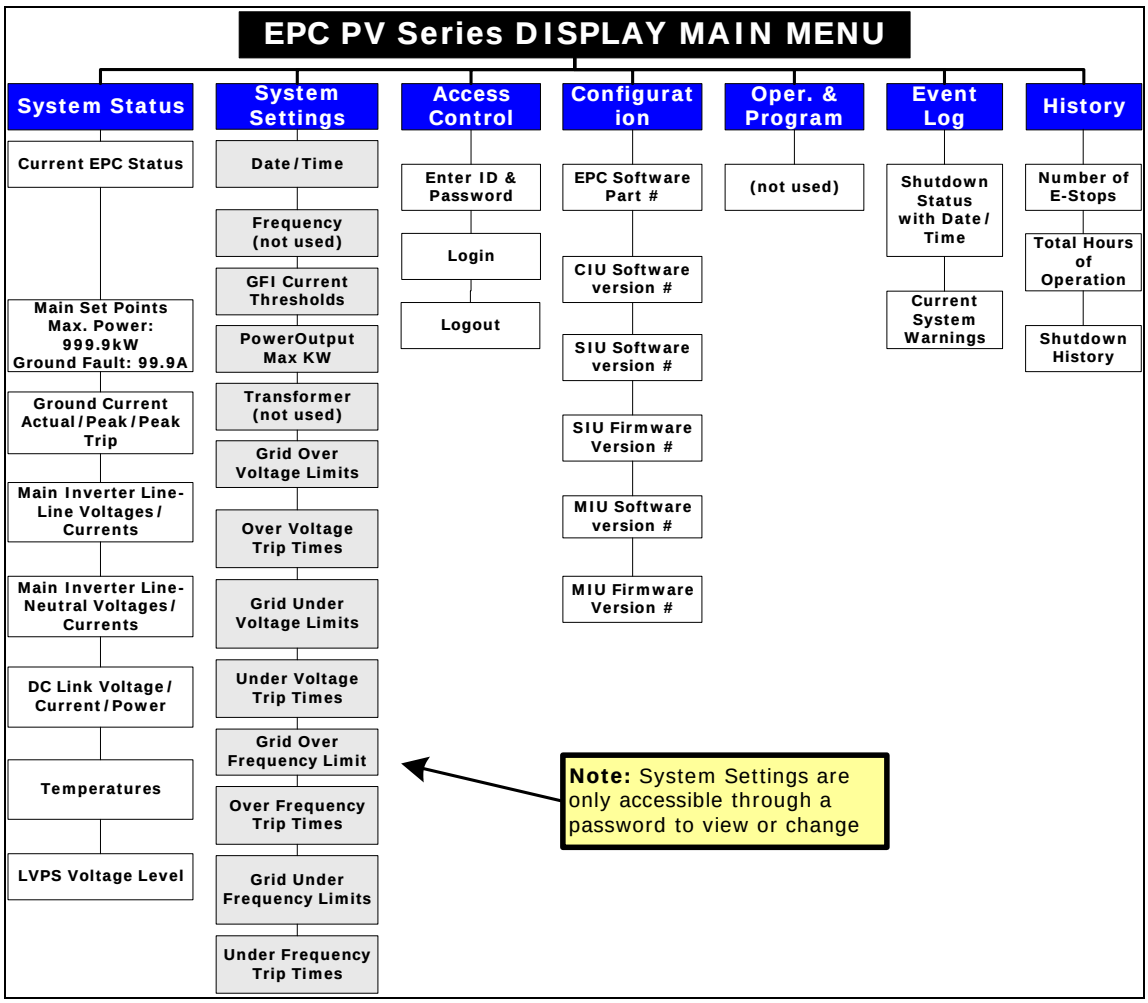
Menu Structure

The main menu items of the inverter display are structured under the following sub-menus:

1. System Status
2. System Settings
3. Access Control
4. Configuration
5. Operation Programming
6. Event Log
7. History

The following chart provides a quick reference of the menu structure:



System Status

This menu displays the current status of the system. Within the System Status menu are several sub-menus that the user can navigate through to find the information desired. The sub-menus are as follows:

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Screen #	Line #	What is displayed	Comments
1	1	Status: Cur State	
	2	Power-on controller; Maintenance mode; Sleep; Idle; Power Delivery; Fault: Service required; Fault Shutdown; Powering Off	
	3	……..kW ……..kWh	Instantaneous Power in kW at grid terminals kWh from cycling the On/Off switch
	4	……Tot kWh	Total accumulated kWh from commissioning
2	1	Status: Date and Time	
	2		
3	1	Status: Main Setpts	
	2	……..kW	Max ac power set point
	3	……Amps	Ground fault set point
4	1	Ground Cur	
	2	……Amps	Actual current sensed by sensor
	3	……Amps	Peak current sensed
	4	……Amps	Peak Trip value when tripped
5	1	Load V-I	
	2	Vab, Ia	All values (Line to Line voltages & line currents) are at the grid interconnect
	3	Vbc, Ib	
	4	Vca, Ic	
6	1	Load V-n	
	2	Van, Ia	Line to neutral voltage and line currents at the grid
	3	Vbn, Ib	
	4	Vcn, Ic	
7	1	DC Bus V&I	
8	1	Temperatures	
	2	Cold Plate –in	The heat sink (lower) temperature*
	3	Cold Plate –out	The heat sink (upper) temperature*
	4	Ambient Temp	Temperature inside enclosure
9	1	Miscellaneous	
	3	……Volts	Low voltage power supply or battery voltage is displayed here

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*** Use the ← and → buttons in the Temperatures menu to toggle between °C and °F.**

System Settings and Operation

Settings

This menu (and its corresponding sub-menus) is used to change the critical operation parameters of the inverter, such as Date/Time, Maximum Power, and Trip Settings. Access to the menu is only available to authorized users who have logged in through the Access Control menu.

This menu can only be viewed and altered if the proper user identity and password has been entered. For more information, refer to *Access Control* in this section.

The menu contains the following screens:

Screen Name	Line #	What is displayed	Comments
Date & Time	2	Date (mm/dd/yy)	Set date
	3	Time (hh:mm)	Set time
	4	"blank"	
GFI Current	2	"blank"	
	3	Threshold: "current" Amps	Set fault current
	4	"blank"	
PwrOutput	2	Max Power Limit in kW	Set max ac power to grid
	3	"blank"	
	4	"blank"	
OVLimits	2	Values in volts	Grid over voltage set point limits
	3	OVlmt1	Grid upper over voltage limit
	4	OVlmt2	Grid lower over voltage limit
OVTripTime	2	Values in msec	Grid over voltage trip time settings
	3	OVcond1	OVlmt1 trip time
	4	OVcond2	OVlmt2 trip time
UVLimits	2	Values in volts	Grid under voltage limits
	3	UVlmt1	Grid upper under voltage limit
	4	UVlmt2	Grid lower under voltage limit
UVTripTime	2	Values in msec	Grid under voltage trip time set points
	3	UVcond1	UVlmt1 trip time
	4	UVcond2	UVlmt2 trip time
OFLimits	2	Values in Hz	Grid over frequency trip frequencies set point
	3	OFlimt1	Grid over frequency limit
	4	"blank"	
OFTripTime	2	Values in msec	Grid over Frequency Trip

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			Time Settings
	3	OFcond1	OFlmt1 trip time
	4	“blank”	
UFLimits	2	Values in Hz	Grid under frequency trip frequencies set points
	3	UFlimt1	Grid under frequency limit-1
	4	Uflimt2	Grid under frequency limit-2
UFTripTime	2	Values in msec	Grid under frequency trip time settings
	3	UFcond1	UFlimt1 trip time
	4	UFcond2	UFlimt2 trip time

Operation

If it is necessary to change a critical initial setup item, do the following:

NOTE: The system can be reconfigured while the unit is using power from the back-up battery.

1. Verify that the EPO is not activated.
2. Turn the manual fused disconnect OFF and disconnect the array from the unit.
3. Turn the On/Off switch to the OFF position. Verify system has completely powered down.
4. Open the cabinet doors after waiting for at least five minutes to allow the dc-capacitors to bleed down
5. Put the maintenance switch in the ON position. Close the cabinet doors.
6. Turn the On/Off switch to the MAN position. The Yellow LED will illuminate solid to indicate maintenance mode.
7. Login to the system through the Access Control menu.
8. Perform the desired changes.
9. Logout of the system through the Access Control menu.
10. Turn the On/Off switch to the OFF position. Verify system has completely powered down.
11. **Cycle key and verify new settings**. Turn the On/Off switch to the OFF position when complete. Verify that the system has completely powered down.
12. Open the cabinet doors. Turn the maintenance switch to the OFF position.

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13. Close and lock the cabinet doors, and turn the manual disconnect ON.

14. Turn the On/Off switch to the MAN position. Verify normal operation.

NOTE: Connecting the unit to the grid will recharge the low voltage battery if it has become discharged during maintenance.

Access Control

The purpose of this menu is to allow authorized users to login to the system to change parameters that require access control. The menu consists of the following two items:

- Login

Acc Cntrl:Login
Enter User: 1
Enter PWD: 9642

- Log-Out

Acc Cntrl: Logout
Press ↵ to Logout
or any other key
to Discard

The password for the inverter is preset. When it is entered, the user is logged-in and can access any of the restricted menu items. To prevent unauthorized access to change parameters, log out after every session. As a back-up, the system will automatically log the user out if the keypad has been inactive for more than ten minutes.

To log out, return to the login screen and follow the instructions.

Configuration

This menu displays the software versions present in the unit. The menu contains the following configuration items:

- Inverter Software Part #
- CIU Software Version #
- MIU Software Version #
- MIU Firmware Version
- SIU Software Version #
- SIU Firmware Version #
- CIU Checksum #
- MIU Checksum #
- SIU Checksum #

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Software and firmware information is vital when troubleshooting a concern. Please record this information before proceeding with diagnostics or contacting your authorized Ballard distributor. The Checksum number is related to UL listing.

Operation Programming

This menu is not presently used. Contact your authorized Ballard distributor for more information.

Event Log

If the menu display is in the Current State display screen and if there is a system fault, the system will automatically navigate to the Event Log menu when any key is pressed. The menu can also be navigated to manually.

Information contained in this menu includes the sequential fault (or warning) number, the module reporting the fault (or warning), and the time/date stamp for the current fault (or warning). The screen also gives a textual display off the fault (or warning). If more than one fault (or warning) is present, the display scrolls automatically through all present faults (or warnings). After the last fault (or warning) is reached, the display continues back to the first. The ← and → keys can be used to override the automatic scrolling.

If manually navigated to this screen and no faults are present, the display will read 'No faults in Service'.

The Event Log menu consists of the following items:

- Shutdown Status
- Current System Warnings

The Current System Warnings screen displays the current warning within the inverter system. The Yellow LED will flash if a warning is present. If a warning has been generated, such as a grid fault, the unit will disconnect from the grid, wait a predetermined amount of time, and try to reconnect. An exception is when a cold plate overtemp warning is detected. In this case, the inverter will derate and continue to flash the Yellow LED until the temperature has reduced or a fault is set.

If a fault has been detected, the inverter will immediately shutdown and the fault condition must be corrected before normal operation can resume. The key-switch needs to be manually cycled.

History

This menu displays historical operational data pertaining to the inverter unit, dating back to the original commission of the unit. It contains the following items:

- Total E-Stops Activated on unit
- Total Operational Hours
- Total kWh from commissioning or when a software reset is done
- Shutdown History (Buffered with Last 10 faults stored)

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NOTE: The warnings (such as when grid parameters are out of range) are not stored in the history.

The Total E-Stops Activated item records the number of times emergency shutdowns have been activated on the unit since commissioning. These are a result of the E-stop button on the control panel being pressed and the heat sink and inductor temperature switches open

The Total Operation Hours item corresponds to the number of hours the power source has run and delivered power to the system since it's commissioning. This number does NOT reset when the key is turned OFF. Hours in sleep mode are not accumulated. When a software upgrade is done or when a board is replaced these numbers could be lost so it is recommended to record the information in history periodically

The Shutdown History item records the last ten faults that resulted in abnormal shutdowns. These are recording in non-volatile memory (turning the unit off or disconnecting the battery will not remove the fault history). The date-time stamp, name of the reporting module, and the textual warning code are saved for each fault. Scroll through the items using the ↑ or ↓ keys. The faults are recorded in a rolling buffer of ten faults. Only the last ten faults are stored along with the date and time stamp.
The History also stores the total kW-hours accumulated from commissioning (assuming there was no software reset or change in the control board.)

Initial System Configuration

To power-up the inverter unit, perform the following:

1. Verify that the enclosure doors are closed.

2. Turn the fused disconnect switch to the ON position.

3. Turn the external dc-disconnect to the array to the ON position.

4. Turn the key to the MAN position.

NOTE: The status LEDs will prove-out when the key is turned to the ON position. If the lights do not prove-out, see *Troubleshooting*.

5. The control panel display will proceed as follows:
   - Power-On Controller
   - *Sleep*, KW, KWh, and Tot kWh– the unit is not connected to the grid yet as measured DC bus voltage is less than the threshold voltage (wake-up voltage). This state is also displayed when the power delivered to the grid falls below the threshold value for a predefined period.
   - *Power Delivery*, KW, KWh, and Tot kWh– the unit is connected to the grid and is delivering power. Also displayed are the Power and Energy delivered to the grid since the unit was last turned ON. (KWh is reset

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when the On/Off switch is cycled Off then ON). Tot kWh is not reset on turning the On/Off switch off.

- *Idle*, KW, kWh, and Tot KWh – the inverter is connected to the grid and is delivering power. The power level during this mode is below threshold level for a predefined period. If this continues, the system transits to sleep mode and if the power increases above the threshold the system transits to *Power Delivery*.

NOTE: Steps 5 and 6 only need to be performed if it is necessary to change system parameters.

6. Navigate to the Access Control menu and enter the unit number and password.

7. Navigate to the System Settings menu and change the desired parameters.

Shutting Down the Unit

In order to shut the inverter down, perform the following:

1. Turn the On/Off switch to the OFF position.

2. The inverter will begin an auto-shutdown procedure, which includes:
   - Powering down transformers
   - Properly shutting down modules
   - Disconnection from the grid
3. The cooling system will shutdown.

4. The inductor fans will run and the battery will be charged in this state.

5. To isolate the inverter, turn the manual fused disconnect to OFF and disconnect the PV array.

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SECTION 600 Maintenance

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Maintenance Procedures 3
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Maintenance Schedule

In order to obtain optimal performance of the inverter, the following items should be addressed at the indicated intervals:

NOTE: Failure to follow the maintenance guidelines may negatively affect the performance of the inverter and may void the warranty.

Recommended Re-Torque of Fasteners

Due to normal thermal cycling, certain fasteners may loosen over time, resulting in increased impedance and possible heat damage. After an initial break-in period of 30 days, all of the fasteners listed in the **Wiring Specifications** table in *Section 200, Specifications* should be re-torqued to the values shown in that table.

Additionally, these fasteners should be checked in 6-month intervals and re-torqued as necessary.

Cooling System

The cooling system should be inspected periodically for leaks and/or corrosion. Also, verify that the reservoir is filled with fluid.

The cooling system should be flushed and refilled every 5 years.

Line Filter Inductor Fan

The fans in the line-filter-inductor should be checked periodically for proper operation. If the fans fail, the inductors protect themselves. The vents should be kept clean to allow proper airflow and proper cooling inside the enclosure.

Enclosure Vents

The enclosure vents should be kept clear of debris. It is suggested that they be checked periodically. The frequency is based on the location.

Maintenance Interval Summary

Maintenance Item	Interval
Re-Torque Field Installed Fasteners	After 30 days from initial start-up; every 12 months thereafter
Cooling System Flush and Refill	Every 5 years
Enclosure Vents Inspection/Cleaning	Every 12 months

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Maintenance Procedures

The following procedures should be used when performing maintenance on the inverter:

Coolant Removal and Replacement

Fig. 1 – Cooling Drain Port Location

1. Turn off the inverter off and disconnect all power sources from the unit.
2. Place a drain pan under the coolant drain port (see **Figure 1**).
3. Remove the reservoir filler cap.
4. Unscrew the coolant drain port plug.
5. Let fluid drain out until no more fluid flows.
6. Screw in the coolant drain port plug. Wrap the threads in Teflon® tape before re-installing the plug.
7. Remove drain pan and dispose of fluid appropriately.
8. Refill the cooling system and purge the system and the coolant loop. Refer to the **Installation Manual**, *Section 400, Cooling System*, *Steps 7*-23, for proper procedure.

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Re-torque Fasteners

Using the appropriate torque wrench, re-torque all fasteners listed in the **Wiring Specifications** table in *Section 200, Specifications (in Installation Manual),* to the torque value indicated in the table. Be careful not to over-torque any connection, as damage to the wiring or terminal may occur.

Enclosure Vents

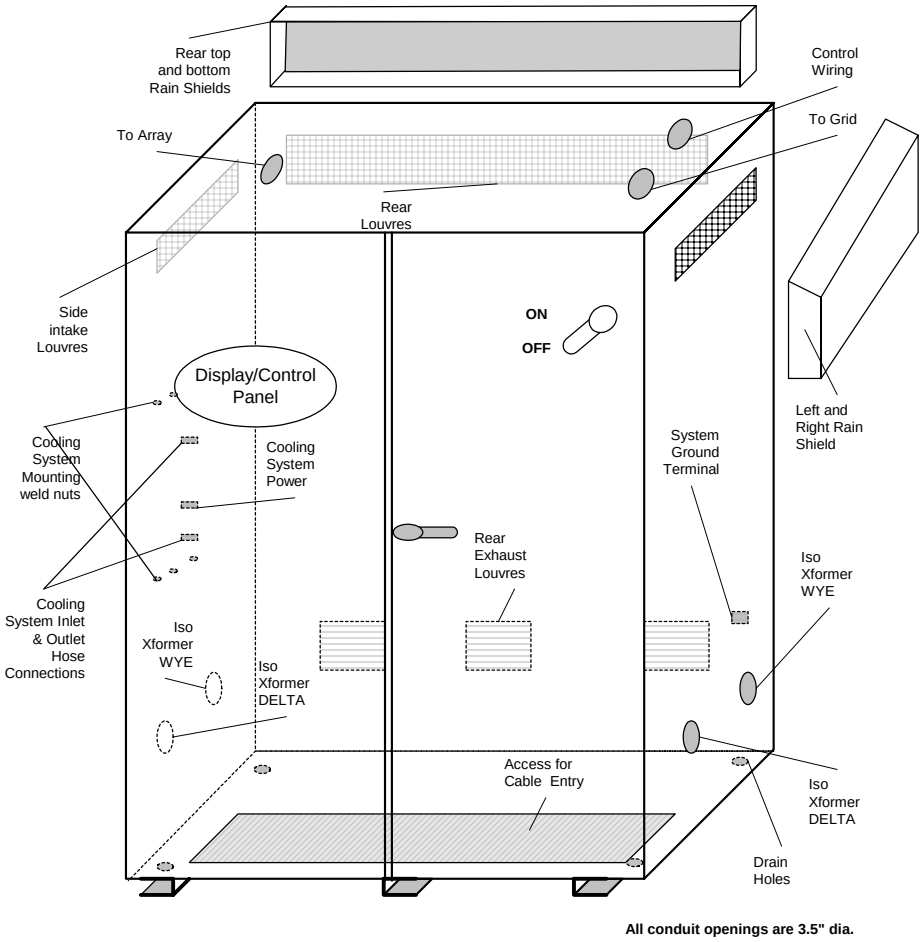

Fig. 2 – Inverter Enclosure Cable Entry Points and Vents

To clean the enclosure vents, spray with compressed air or vacuum. Be sure to check all vents, **Figure 2**. If using compressed air, it is advisable to vacuum the inside of the enclosure after the vents have been cleaned. **Make sure the unit is isolated before servicing the inside of the enclosure** (see *Section 500, Operating the Unit*).

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SECTION 700 Troubleshooting

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Overview

The inverter is equipped with an extensive amount of on-board diagnostics. Through the control panel, the inverter is able to display trouble codes that can guide the user or service technician to the root cause of a concern.

The following chart contains a complete list of all the trouble codes able to be generated by the unit, along with a description of the code and the appropriate action to take.

In all instances, if the recommended action to take does not repair the concern, contact your authorized Ballard service center for more in-depth diagnosis. The nomenclature used is:
CIU (SD/W): Fault reported by the CIU controller and (SD) leads to a shut-down of the unit or (W) leads to a warning and when the warning is cleared the unit becomes fully operational.
MIC (SD/W): Faults and warnings reported by the main inverter controller
SIC (SD/W): Faults and warnings reported by the source inverter controller

	WARNING! **When a warning is cleared such as a grid over voltage, the inverter will connect itself automatically to the grid. Warnings are labeled in the table below.** **In the table below in column one SD type faults that are critical are marked with an *. When these faults occur inverter will immediately shutdown and will not restart.** .
	RESTART LOGIC On non-critical shut down type faults the inverter will attempt up to three restarts with a 5-minute delay between restarts. During the restart mode the inverter displays "Restarting" with a 5 minute count down timer. If the fault is cleared and the inverter runs for 5 minutes, the restart counter is reset. If the fault is not cleared after three unsuccessful restart attempts, the inverter will shutdown and will require manual intervention. Any time during the restart mode if an operator touches the keypad, the unit will abort restart mode and immediately shut down to allow the operator to address the fault. **Faults/Warnings Table** Faults for which the above restart logic is used are highlighted in the following faults/warnings table.

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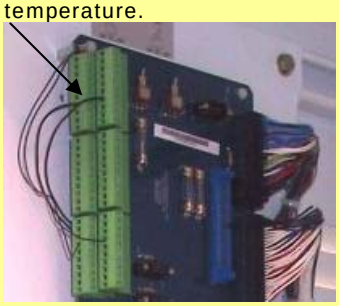
(Continued)

Troubleshooting Procedures

Fault and Warning Messages

Module (Fault Type)	Display Message	Description	Action to Take
CIU (SD)	AmbTempSnsr OutOfRng	Enclosure ambient temperature sensor out-of-range	• Check integrity of wiring to enclosure ambient temperature.  •
MIC (SD)	SyncErr TimeOut Shut	Inverter voltage out range before synchronization	Contact your authorized Ballard service center.
MIC (W)	ExtProtRelayTripped	External protection relay circuit	Inspect external wiring. Fault does not lie within the unit.
MIC (W)	CPOverTemperature	Cold plate temperature exceeds maximum value	• Check cooling system for: ▪ Airflow through radiator ▪ Ambient temperature around enclosure ▪ Fan not running
MIC (W)	DC Link O_Voltage	DC bus voltage exceeds maximum limit (600Vdc)	• Check source for over voltage. • Check source for improper grounding.
MIC (W)	Grid O_Freq	Grid frequency exceeds user limit maximum	• Check trip settings. • Verify that manual fused disconnect is ON. • Verify that all fuses are OK. • **NOTE: Unit will reconnect automatically after 5 minutes after frequency is within range.**
MIC (W)	Grid O_Voltage	Grid voltage of any phase is above user limit	• Check trip settings. • Verify that manual fused disconnect is ON. • Verify that all fuses are OK. • **NOTE: Unit will reconnect automatically after 5 minutes after voltage is within range.**

(continued)

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Module (Fault Type)	Display Message	Description	Action to Take
MIC (W)	Grid U_Freq	Grid frequency below user limit	• Check trip settings. • Verify that manual fused disconnect is ON. • Verify that all fuses are OK. • **NOTE: Unit will reconnect automatically after 5 minutes after frequency is within range.**
MIC (W)	Grid U_Voltage	Grid voltage of any phase is below user limit.	• Check trip settings. • Verify that manual fused disconnect is ON. • Verify that all fuses are OK. • **NOTE: Unit will reconnect automatically after 5 minutes after Voltage is within range.**
MIC (W)	Power Limit	Output is limited to set limit	• Verify maximum power limit set point.
CIU (SD)	CIU Faulted	Internal CIU fault detected	• Look for other fault displayed simultaneously. • Contact your authorized Ballard service center.
CIU (SD)	Control Val Not Rec	Initial control messages not received by MIC and SIC	• Contact your authorized Ballard service center.
CIU (SD)*	Controller Mode Err	Incorrect model numbers detected during prepare to start	Contact your authorized Ballard service center.
MIC (SD)	CoolantFlow Loss SD	Loss of coolant flow over predefined time	• Check coolant level. • Inspect auxiliary fuses. Check for integrity of flow switch wiring.
MIC (SD)	CoolantFlow PwrUpFlt	Coolant flow switch open at power up	• Check integrity of wiring to flow switch.
MIC (SD)	CPlate OverTemp SD	Cold plate temperature exceeded the limit	• Inspect for blocked vents, fan inlet, restricted cooling radiator. • Isolate cause of high ambient temperature.
CIU, MIC, SIC (SD)	CritModCommunctnErr	Internal module communication has failed	• Check fuses on ITB Board.
MIC (SD)	DcLink OVoltage SD	DC bus voltage is over the maximum limit	• Check array wiriing • Contact your authorized Ballard service center.
MIC, SIC (SD)*	Emergency PowerOff	EPO switch is activated	• Determine why EPO switch is activated. • Release EPO switch, if appropriate.
CIU (SD)*	EPO	Emergency stop input is active	• Determine why EPO switch is activated. • Release EPO switch, if appropriate

(continued)

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Module (Fault Type)	Display Message	Description	Action to Take
MIC (SD)*	GridPhSeq reversed	Phase sequence of the grid is reversed	• Check wiring per installation manual. • Verify manual fused disconnect is ON. • Check fuses on VSB. • Verify phase rotation sequence is correct.
SIC (SD)	Ground Fault	Ground current exceeded threshold limit	• Verify GFD setting is correct. • Verify array connections.
MIC (SD)	Inv Over Frequency	Output frequency is above the limit	• This may have been generated from a separate error. Address other DTCs first. • If code remains, contact your authorized Ballard service center.
MIC (SD)	Inv Under Frequency	Output frequency is below the limit	• This may have been generated from a separate error. Address other DTCs first. • If code remains, contact your authorized Ballard service center
MIC (SD)*	K1 Welded	Feedback signal from K1 contactor indicates welded contactor	• Contact your authorized Ballard service center.
MIC (SD)	K1Failure to Close	Error in feedback signal from K1 contactor	• Check for a loose harness connection on the output contactors on the right panel.
CIU (SD)	Key Fault	Key input is in an invalid state	• Contact your authorized Ballard service center.
MIC (SD)	Over Current	Output current exceeds over current limit	• Contact your authorized Ballard service center.
MIC (SD)*	Over Current Short	Power stage short-circuited	• Contact your authorized Ballard service center.
CIU (SD)	Overtemp Shutdown	The cabinet temperature has exceeded limit.	• Verify all air intake vents are free from debris. • Check for proper operation of inductor fans. • Verify temp sensor is correctly wired to ITB Board.
CIU (SD)	LVPS low voltage	LVPS voltage low	• Ensure grid is on • Check LVPS for integrity • Check LVPS wiring integrity • Check Aux fuse
CIU (W)	Battery Low	Battery voltage below 10.5V and grid/LVPS off	• Verify grid and LVPS as above • Disconnect battery until issue is resolved
MIC (SD)*	Single Phase Fault	Open phase before or after output transformer	• Inspect fuses F4, F5, and F6. Replace any blown fuses. • Verify grid transformer connections.
MIC (SD)	UnitResp TimeOut	Internal communication time-out	• Contact your authorized Ballard service center.

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Module (Fault Type)	Display Message	Description	Action to Take
CIU (W)	AmbTemp Too High	Enclosure temperature as measured by the CIU exceeded 70 degrees C.	• Check for blocked vents • Check ITB Fuse 7 • Check for fan failures • Check for other sources of high temperature inside
SIC (SD)	Ext AD A	Internal controller fault.	Contact your authorized Ballard service center.
SIC (SD)	Ext AD B	Internal controller fault.	Contact your authorized Ballard service center.
SIC (SD)*	Flash Checksum	Internal controller fault.	Contact your authorized Ballard service center.
SIC (SD)	LCA Hw Fault	Internal controller fault.	Contact your authorized Ballard service center.
SIC (SD)	EPC-S Softwr OvFlow	Internal controller fault.	Contact your authorized Ballard service center.
MIC (W)	Too Cold for Startup	Either the Ambient Temperature as measured by the CIU or the HS Temperature as measured by the MIC was less than -20 degrees C.	Wait until both sensors read greater than -20 degrees C --- then warning will clear.
MIC (SD)	Phase Out U-Voltage	While attemtping to synchronize to the grid, the phase voltage measured by the MIC was not within expected range.	• Check VSB fuses and connectors • Contact your authorized Ballard service center.
MIC (SD)	Phase Out O-Voltage	While attemtping to synchronize to the grid, the phase voltage measured by the MIC was not within expected range.	• Check VSB fuses and connectors • Contact your authorized Ballard service center.
MIC (SD)	DC Bus Hw Fault SD	Internal controller fault.	• Contact your authorized Ballard service center.
MIC (SD)	EPC-M Softwr OvFlow	Internal controller fault.	• Contact your authorized Ballard service center.
MIC (SD)	Offset Ir SD	"Zero-current" value as read by the controller not within acceptable range.	• Contact your authorized Ballard service center.
MIC (SD)	Offset Is SD	"Zero-current" value as read by the controller not within acceptable range.	• Contact your authorized Ballard service center.
MIC (SD)*	Flash Checksum	Internal controller fault.	• Contact your authorized Ballard service center.
MIC (SD)	LCA Hw Fault	Internal controller fault.	• Contact your authorized Ballard service dealer.
MIC (SD)*	ProgrmConfigInvalid	Internal controller fault.	• Contact your authorized Ballard service center.
MIC (SD)	Ext AD A	Internal controller fault.	• Contact your authorized Ballard service center.
MIC (SD)	Ext AD B	Internal controller fault.	• Contact your authorized Ballard service center.

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Symptom Chart (no codes generated)

The following table lists some fault conditions that will not set trouble codes, but can be preliminarily diagnosed by the operator.

As with the warning and shutdown messages, if the recommended action to take does not repair the concern, contact your authorized Ballard service center for more in-depth diagnosis.

Symptom	Possible Cause(s)	Action to Take
The display does not power up after the key is turned ON; or the display momentarily powers up then flashes.	• No grid power present • Display is not connected • LVPS inoperative	• Check the utility voltage • Check grid power to the 15 VDC power supply • Turn key OFF • Check J10 connector inside the main cabinet, and the connector on the back of the display
The display freezes after the key is turned ON.	• LVPS inoperative • Display cable	• Verify that the connection from the display panel to the ITB board is secure.
The display stays on after the key is turned OFF.	• Communication failure between the inverter and display • On/Off switch faulted	• Verify that the connection from the display panel to the ITB board is secure.

Fuse Replacement

The inverter contains various styles of fuses at various locations throughout the unit. When replacing a fuse, always use one of the same type and rating as the original fuse. This helps in avoiding fires and prevents possible damage to the unit.

Warning: Before replacing a fuse, verify that the Low Voltage Battery and Low Voltage Power Supply are disabled. Also, verify that the Manual Fused Disconnect is turned OFF. Failure to do so may result in electrical shock causing injury or death. Isolate the PV array by opening the DC-disconnect.

CAUTION: Use proper fuse removal tools when removing fuses.

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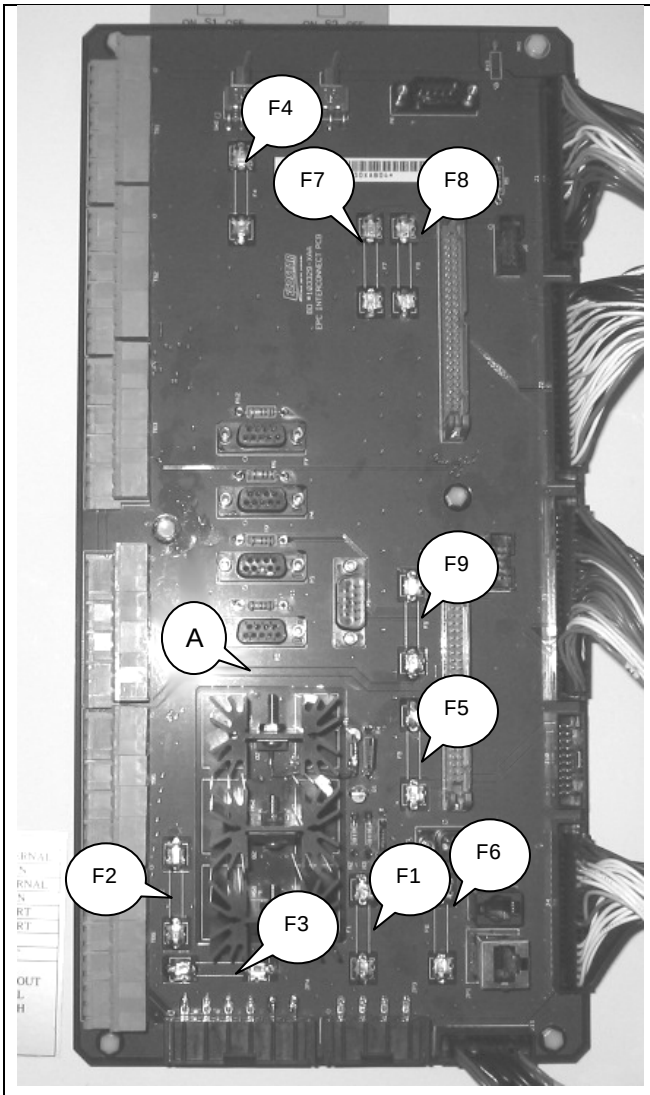
ITB Board



Fuse	Rating	BUSSMANN Part Number	COLOR BAND	Description
F1	10A	AGC-10RX	RED	Battery input fuse
F2	15A	AGC-15EX	LT. BLUE	LVPS input fuse
F3	5A	AGC-5TX	TAN	LVPS to site fuse
F4	5A	AGC-5TX	TAN	LVPS to system fuse
F5	5A	AGC-5TX	TAN	LVPS to display/EPO fuse
F6	5A	AGC-5TX	TAN	LVPS to inductor fan fuse
F7	5A	AGC-5TX	TAN	LVPS to starter fuse
F8	5A	AGC-5TX	TAN	LVPS to CIU fuse
F9	5A	AGC-5TX	TAN	LVPS to main fuse

A	Interface Terminal Block (ITB) Board
F1-F9	Fuses

Removal

1. Pull the fuse (F1-F9) from the slot. Be careful not to flex the circuit board (A).

Installation

1. Installation is the reverse of removal.

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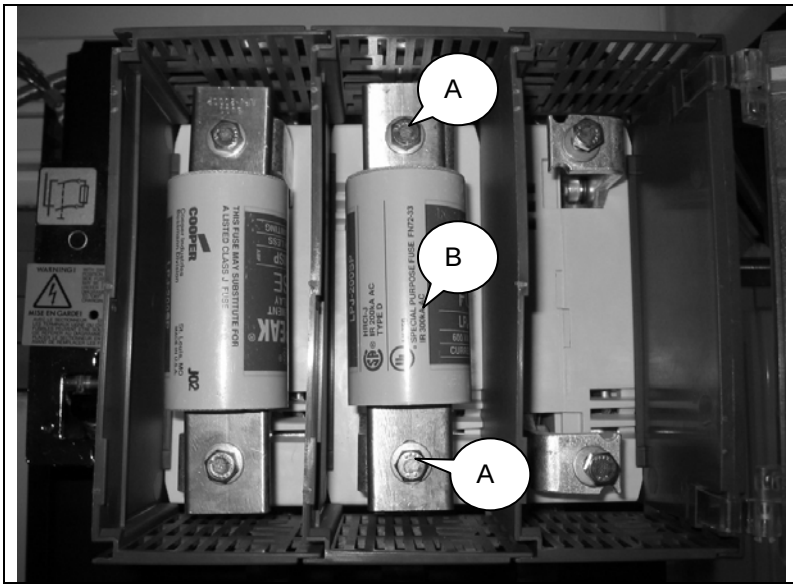
Manual Fused Disconnect



Fuse Make: Bussmann
Fuse Part #: LPJ-300SP
Current Rating: 300A
Qty. per system: 3

A	Bolt
B	Fuse

Removal

1. Remove the bolts (A).
2. Remove the fuse (B).

Installation

1. Installation is the reverse of removal.

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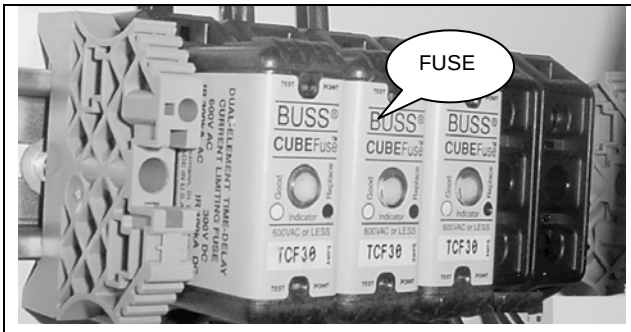
Auxiliary Fuse Block



Fuse Make: Bussman
Fuse Part #: TCF30
Qty. per system: 3

FUSE	Fuse

NOTE: The auxiliary fuses have a window indicating whether the fuse is blown or intact.

Removal

1. Pull the fuse (FUSE) from its slot.

Installation

1. Installation is the reverse of removal.

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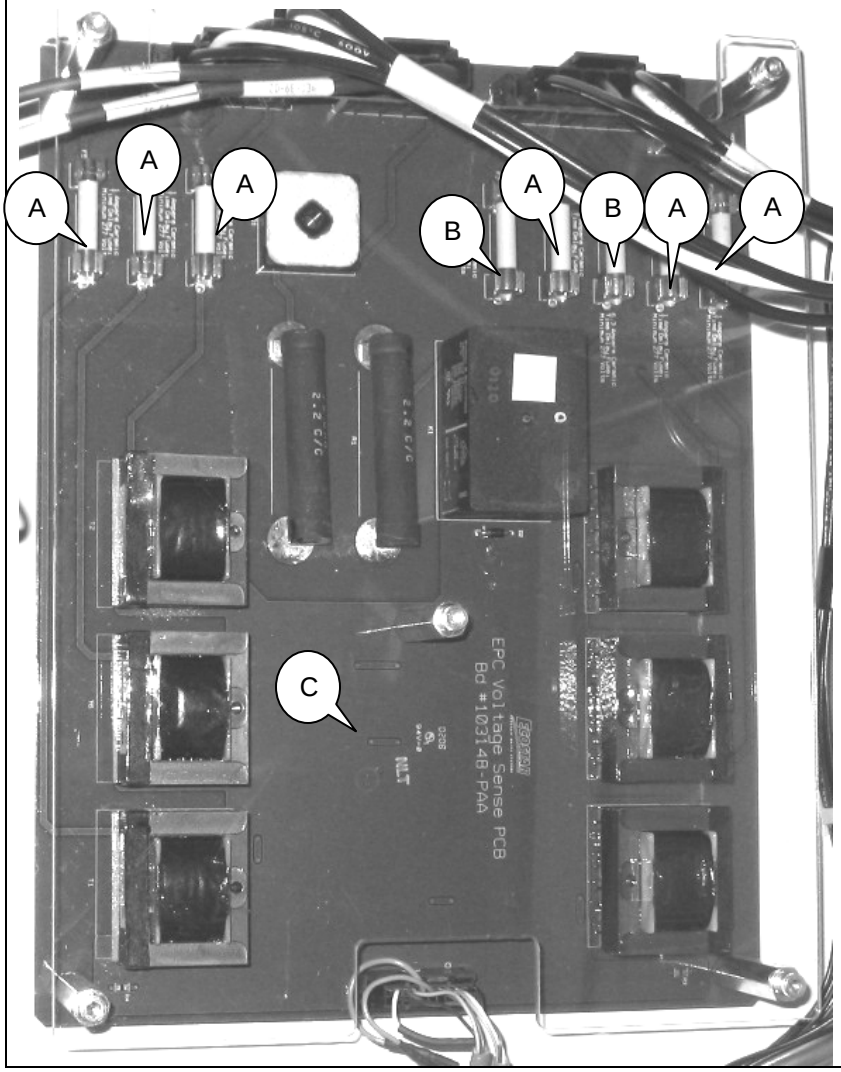
Voltage Sense and Precharge (VSP) Board



Fuse Make: Wickmann
Fuse Part #: 3561100002
Amps: 1.0, ceramic
Type: Time delay
Voltage: 440V

Fuse Make: Wickmann
Fuse Part #: 356163002
Amps: 6.3, Ceramic
Type: Time Delay
Voltage: 440V

A	Fuse (3561100002)
B	Fuse (356163002)
C	VSP Board

Removal

1. Pull the fuse (A or B) from the slot. Be careful not to flex the circuit board (C).

Installation

1. Installation is the reverse of removal.

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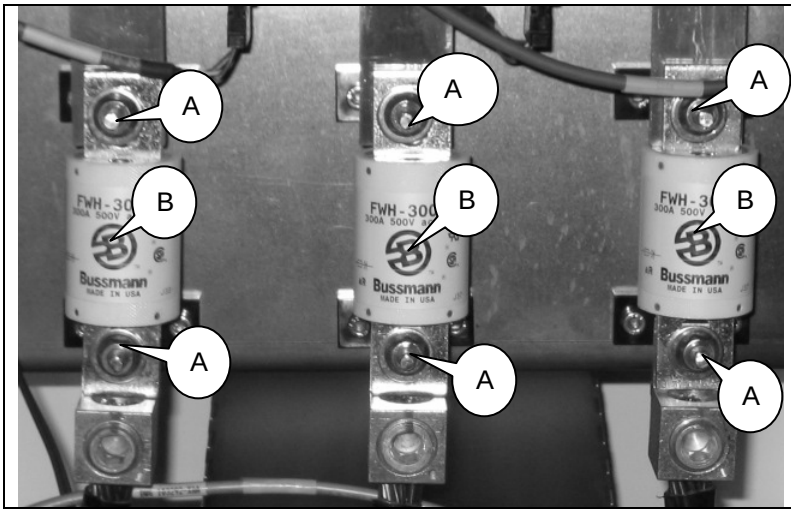
Main Inverter Output Fuse



Make: Bussmann
Part #: FWH-300A
Current Rating: 300A
Qty. per system: 3

A	Nut	-
B	Main Inverter Output Fuse	103190

Removal

1. Remove the nuts (A).

2. Replace the main inverter output fuse (B).

Installation

1. Installation is the reverse of removal.

NOTE: Hold the compression lugs while tightening the cables to avoid damaging the fuse stand-offs.

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Supplement

Wiring Schematics

Page 1: System Overview

Page 2: Low Voltage Power Supply

Page 3: Harness Overview

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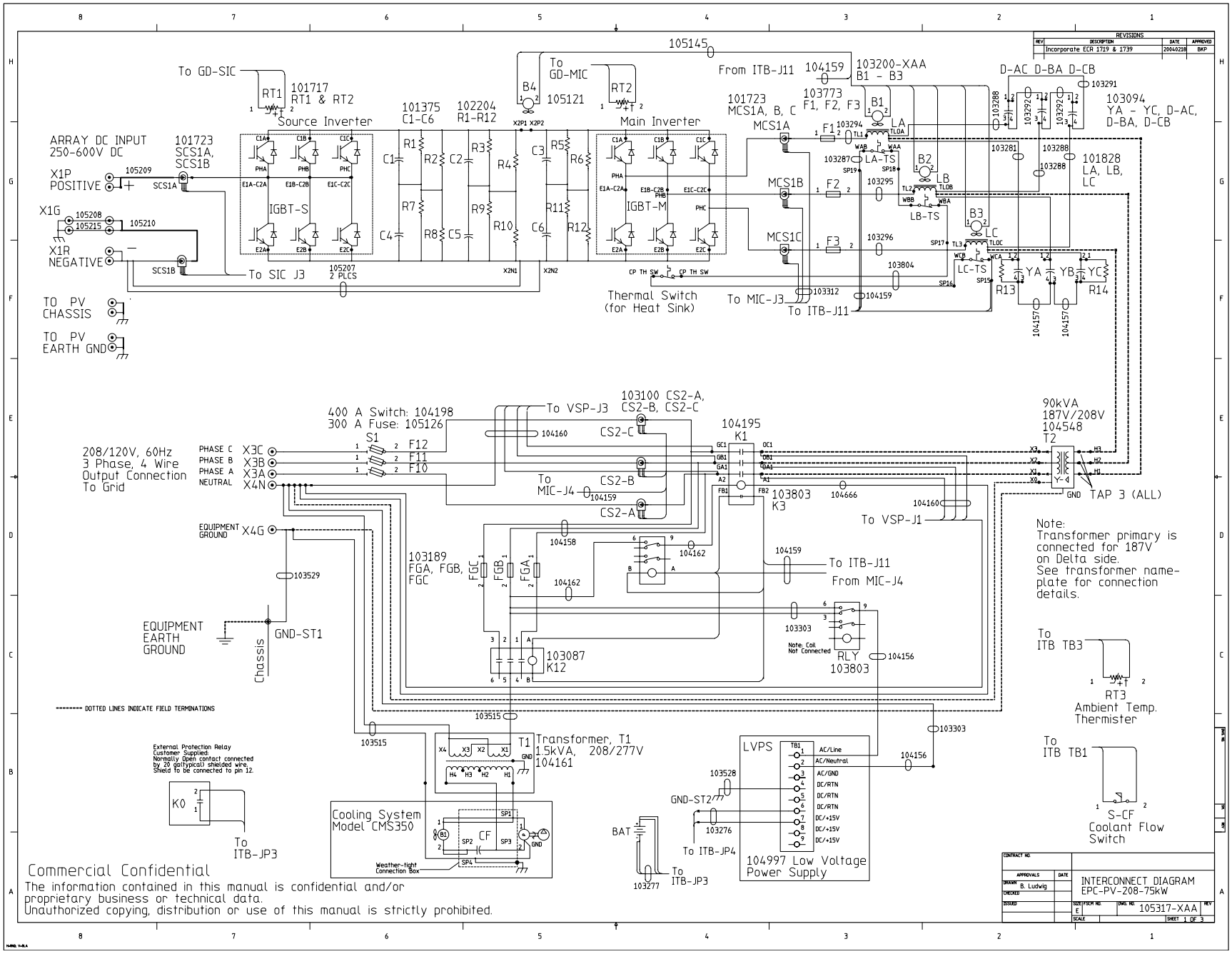
REVISIONS
REV | DESCRIPTION | DATE | APPROVED
Incorporate ECR 1719 & 1739 | 20040218 | BKP
105145
To GD-SIC
RT1
101717
RT1 & RT2
Source Inverter
To GD-MIC
B4
105121
RT2
Main Inverter
From ITB-J11
104159
103200-XAA
B1 - B3
D-AC D-BA D-CB
103291
103094
YA - YC, D-AC, D-BA, D-CB
101375
C1-C6
102204
R1-R12
101723
MCS1A, B, C
103773
F1, F2, F3
ARRAY DC INPUT
250-600V DC
101723
SCS1A,
SCS1B
X1P
POSITIVE
105209
SCS1A
X1G
105208
105215
105210
X1R
NEGATIVE
SCS1B
IGBT-S
IGBT-M
105207
2 PLCS
To SIC J3
X2N1
X2N2
X2P1 X2P2
CP TH SW
Thermal Switch
(for Heat Sink)
MCS1A
MCS1B
MCS1C
F1
F2
F3
103294
103295
103296
LA
LA-TS
LB
LB-TS
LC
LC-TS
B1
B2
B3
103287
103281
103288
101828
LA, LB, LC
103804
103312
To MIC-J3
104159
To ITB-J11
YA
YB
YC
R13
R14
104157
TO PV
CHASSIS
TO PV
EARTH GND
400 A Switch: 104198
300 A Fuse: 105126
S1
F12
F11
F10
To VSP-J3
104160
103100 CS2-A,
CS2-B, CS2-C
CS2-C
CS2-B
CS2-A
104195
K1
90kVA
187V/208V
104548
T2
208/120V, 60Hz
3 Phase, 4 Wire
Output Connection
To Grid
PHASE C X3C
PHASE B X3B
PHASE A X3A
NEUTRAL X4N
To MIC-J4
104159
103803
K3
104666
104160
To VSP-J1
GND
TAP 3 (ALL)
EQUIPMENT GROUND X4G
103529
103189
FGA, FGB, FGC
104158
104162
104159
To ITB-J11
From MIC-J4
103303
Note: Coil Not Connected
RLY
103803
104156
103087
K12
EQUIPMENT EARTH GROUND
GND-ST1
Chassis
Note:
Transformer primary is connected for 187V on Delta side.
See transformer name-plate for connection details.
To ITB TB3
RT3
Ambient Temp. Thermister
To ITB TB1
S-CF
Coolant Flow Switch
DOTTED LINES INDICATE FIELD TERMINATIONS
103515
External Protection Relay
Customer Supplied:
Normally Open contact connected by 20 ga(typical) shielded wire.
Shield to be connected to pin 12.
K0
To ITB-JP3
T1
Transformer, T1
15kVA, 208/277V
104161
Cooling System
Model CMS350
SP1
SP2
CF
SP3
SP4
Weather-tight Connection Box
BAT
103277
To ITB-JP3
LVPS
TB1
AC/Line
AC/Neutral
AC/GND
DC/RTN
DC/RTN
DC/RTN
DC/+15V
DC/+15V
DC/+15V
103528
GND-ST2
103276
To ITB-JP4
104997 Low Voltage Power Supply
104156
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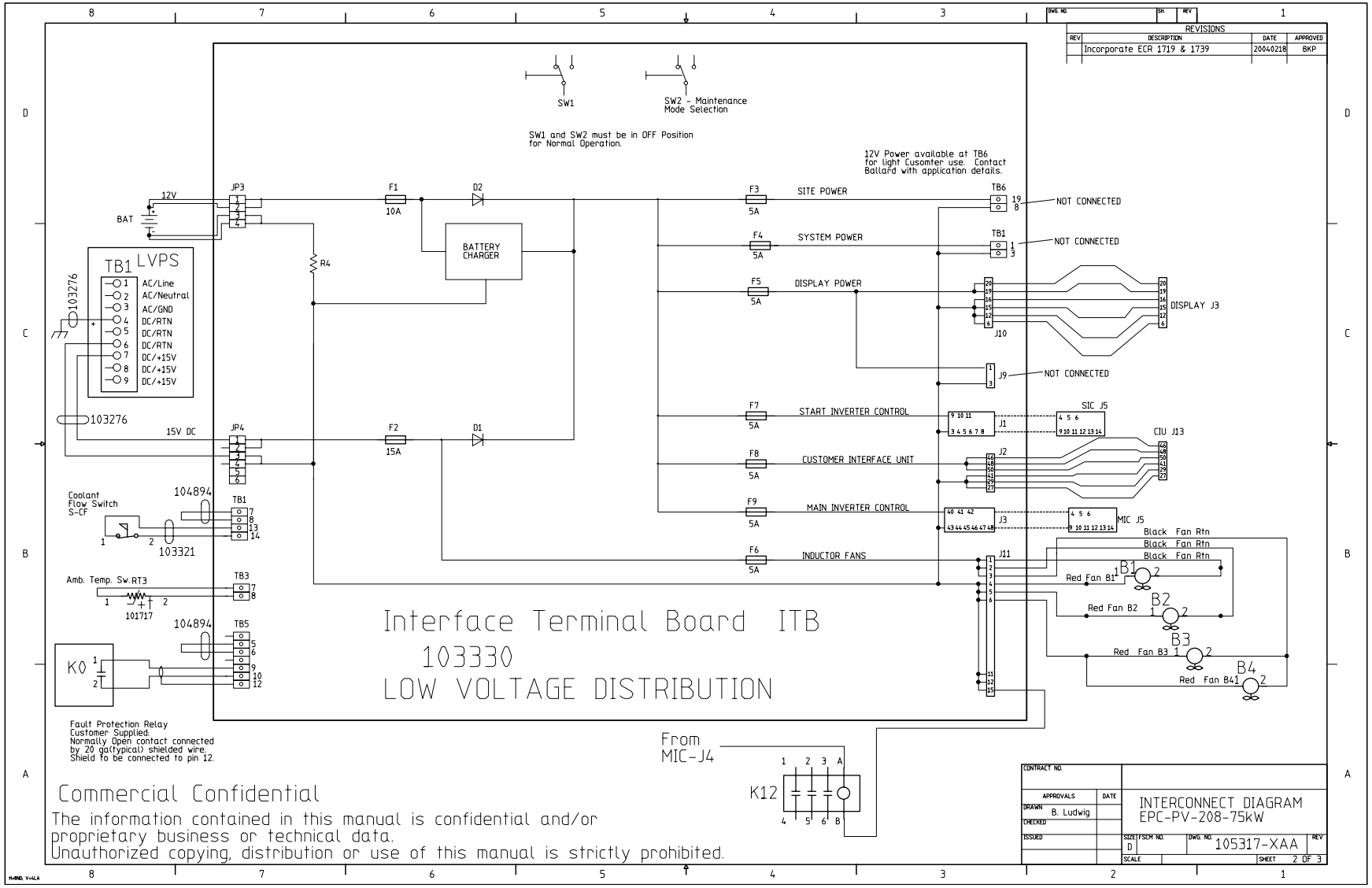
CONTRACT NO.
APPROVALS
DRAWN B. Ludwig
CHECKED
ISSUED
DATE
INTERCONNECT DIAGRAM
EPC-PV-208-75kW
SIZE | FSCM NO. | DWG NO. | REV
E | 105317-XAA
SCALE
SHEET 1 OF 3


REVISIONS
REV DESCRIPTION DATE APPROVED
Incorporate ECR 1719 & 1739 20040218 BKP
SW1
SW2 - Maintenance Mode Selection
SW1 and SW2 must be in OFF Position for Normal Operation.
12V Power available at TB6 for light Cusomter use. Contact Ballard with application details.
12V
BAT
JP3
F1 10A
D2
BATTERY CHARGER
R4
TB1 LVPS
1 AC/Line
2 AC/Neutral
3 AC/GND
4 DC/RTN
5 DC/RTN
6 DC/RTN
7 DC/+15V
8 DC/+15V
9 DC/+15V
103276
103276
15V DC
JP4
F2 15A
D1
F3 5A SITE POWER
F4 5A SYSTEM POWER
F5 5A DISPLAY POWER
F7 5A START INVERTER CONTROL
F8 5A CUSTOMER INTERFACE UNIT
F9 5A MAIN INVERTER CONTROL
F6 5A INDUCTOR FANS
TB6
NOT CONNECTED
TB1
NOT CONNECTED
DISPLAY J3
J10
J9
NOT CONNECTED
SIC J5
J1
CIU J13
J2
MIC J5
J3
J11
Black Fan Rtn
Black Fan Rtn
Black Fan Rtn
Red Fan B1
Red Fan B2
Red Fan B3
Red Fan B41
B1
B2
B3
B4
Coolant Flow Switch S-CF
104894
103321
TB1
Amb. Temp. Sw. RT3
101717
TB3
104894
TB5
K0
Fault Protection Relay Customer Supplied: Normally Open contact connected by 20 ga(typical) shielded wire. Shield to be connected to pin 12.
Interface Terminal Board ITB
103330
LOW VOLTAGE DISTRIBUTION
From MIC-J4
K12
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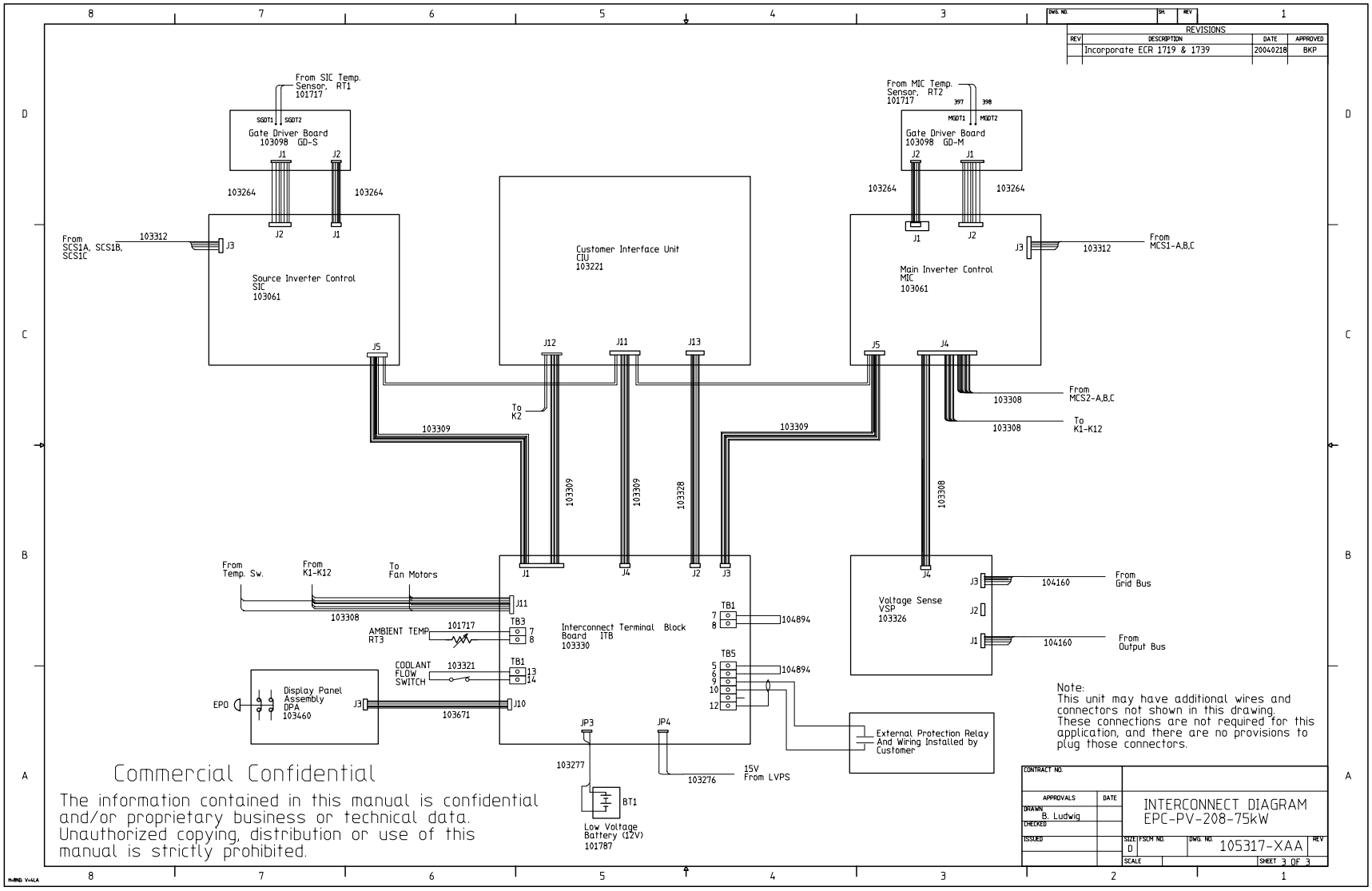
CONTRACT NO.
APPROVALS DATE
DRAWN B. Ludwig
CHECKED
ISSUED
INTERCONNECT DIAGRAM
EPC-PV-208-75kW
SIZE D
FSCM NO.
DWG. NO. 105317-XAA
REV
SCALE
SHEET 2 OF 3


REVISIONS
REV | DESCRIPTION | DATE | APPROVED
Incorporate ECR 1719 & 1739 | 20040218 | BKP
From SIC Temp. Sensor, RT1 101717
Gate Driver Board 103098 GD-S
From MIC Temp. Sensor, RT2 101717
Gate Driver Board 103098 GD-M
Source Inverter Control SIC 103061
Customer Interface Unit CIU 103221
Main Inverter Control MIC 103061
From SCS1A, SCS1B, SCS1C
From MCS1-A,B,C
From MCS2-A,B,C
To K1-K12
To K2
103264
103312
103309
103308
103328
From Temp. Sw.
From K1-K12
To Fan Motors
AMBIENT TEMP RT3
101717
COOLANT FLOW SWITCH
103321
Interconnect Terminal Board ITB 103330
Display Panel Assembly DPA 103460
EPO
103671
JP3
JP4
103277
103276
15V From LVPS
BT1
Low Voltage Battery (12V) 101787
External Protection Relay And Wiring Installed by Customer
Voltage Sense VSP 103326
104160
From Grid Bus
From Output Bus
104894
Note:
This unit may have additional wires and connectors not shown in this drawing. These connections are not required for this application, and there are no provisions to plug those connectors.
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CONTRACT NO.
APPROVALS | DATE
DRAWN B. Ludwig
CHECKED
ISSUED
INTERCONNECT DIAGRAM EPC-PV-208-75kW
SIZE D | FSCM NO. | DWG. NO. 105317-XAA | REV
SCALE | SHEET 3 OF 3